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Telecommunications and information exchange between systems — Future network protocols and mechanisms —

Part 2:
Proxy model-based quality of service

Télécommunications et échange d'informations entre systèmes — Futurs protocoles et mécanismes de réseau —

Partie 2: Qualité de service basée sur un modèle de proxy

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

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Introduction

This document and ISO/IEC 21558-2 both pertain to the Future Network (FN), which is a broad concept and has a wide application. The FNProxy technology introduced by ISO/IEC 21558-2 enables the future network quality of service (FNQoS), which makes the FNQoS appear to be a mutual relationship between intelligent FNProxies (i.e. harmonization between machines), not like the micro effect of traditional QoS which depends on parameters.

The fact that FNProxy can promote the evolution of QoS to harmonize the process of networking. It provides new forms of networking besides new concepts of QoS. This can lead to the emergence of new industry trends in the field of systems interconnection technology.

This document specifies three engines (perception, negotiation and execution) to support the effective work of FNProxy. This document also describes protocol mechanisms for synchronous interaction between two FNProxies and among multiple FNProxies. Also, conditions and requirements for service transitions between/among FNProxies are described. Annex A gives the quantitative calculation method (harmonization between FNProxies) of interaction QoS effect, which can be used as a starting point reference for developers to improve the calculation method.

Duo to the intelligence of FNProxy, synchronous interactions of Bidirectional Service (Bi-S) between FNProxies have more extensive effects. Bi-S is necessary: a fundamental methodology, tool, and idea to analyse and develop FNQoS systems.

This document explains in detail the protocol mechanisms of FNProxy interactions from two perspectives: 1) the basic FNQoS system (BFS) 2) synthetic FNQoS system (SFS).

This document stipulates that protocol mechanisms can be used for all networks for transmission purposes, and also for generalized networks, such as the implementation of semantic network protocol mechanisms. The development of various network technologies based on Artificial Intelligence Enabled Networking (AIEN) is recommended.

This document stipulates that the purpose of interactions between FNProxies can be either transmission interactions or content interactions.

The protocol mechanism specified in this document is applicable to ISO/IEC TR 29181-8 and ISO/IEC 21558-2.

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Telecommunications and information exchange between systems — Future network protocols and mechanisms —

Part 2:
Proxy model-based quality of service

1 Scope

The concept of this document considers the FNQoS related to the FNProxy based in ISO/IEC TR 29181-8.

The protocol mechanism given in this document supports both the interaction between two FNProxies of a basic FNQoS system (BFS) and the interaction among multiple FNProxies in a synthetic FNQoS system (SFS).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 21558-2, *Telecommunications and information exchange between systems — Future Network — Architecture — Part 2: Proxy Model based Quality of Service*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO/IEC 21558-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
service transition
FNProxy transfers the requirements that it cannot serve to the corresponding FNProxy

Note 1 to entry: FNProxy service transition must be based on the FNProxy's own strategy and real-time information.

Note 2 to entry: That the direction of service transition can also be determined by the information of Bi-Ss (FNProxy link pairs) stored in the *FNProxy Interaction Bridge (FIB)* (3.1.2) of the FNQoS system. By default, the transition direction is based on the information stored in FIB.

3.1.2
FNProxy Interaction Bridge
FIB
linking path of two FNProxies in SFS

Note 1 to entry: It includes logical paths to realize the interactive exchange of information between any two FNProxies in a synthetic FNQoS system (SFS) consisting of bidirectional service (Bi-S) pairs by cascading.

3.1.3
FNProxy Link Mode
FLM
FNProxy linking template

Note 1 to entry: It is used to normalizing the design, evaluation and calculation of binding, identification, registration, management, bidirectional service (Bi-S) and negotiation for different styles of FNProxy link in a synthetic FNQoS system (SFS).

Note 2 to entry: Several FLMs are listed in Annex D. When FLM is used by the designer, it means that the transition direction of the FNProxy is not random but known in advance. The negotiation strategy (NS) of the FNProxy will set the requirement type percepting function of the perception engine of FNProxy to sleep.

3.1.4
FNProxy Protocol Data Unit
FPDU
data unit needed by the interaction between two FNProxies in an FNQoS system

3.1.5
BFS Protocol
BFSP
set of FPDU fields, semantic changes and timing needed by all procedures supported by the two FNProxies of BFS

3.1.6
SFS Protocol
SFSP
set of FPDU fields, semantic changes and time sequence of all procedures among all FNProxies in a SFS

3.1.7
FNProxy Strategy
FNPS
predetermined response of FNProxy

Note 1 to entry: It is for some important states or comprehensive effects of an FNQoS system based on the environment of FNQoS system, the characteristics and capability of the FNProxy, the target of the FNProxy owner and the real-time running status of the FNProxy.

Note 2 to entry: The FNProxy Strategy (response measures, scheme) and its solutions (sub schemes) are stored in the FNProxy Strategy Base (FSB).

3.1.8
procedure
interaction sequence between FNProxies to complete the special tasks in the FNQoS system

Note 1 to entry: The comprehensive effect of FNQoS system consists of several procedures dynamically. It is generally expressed in the form of a sequence diagram.

3.2 Abbreviated terms

AI	Artificial Intelligence
AIEN	Artificial Intelligence Enabled Networking

ALF	Access Layer FNProxy
BFS	Basic FNQoS System
BFSP	BFS Protocol
Bi-S	Bidirectional Service
BS	Base Station
ES	Execution Strategy
FIB	FNProxy Interaction Bridge
FN	Future Network
FPDU	FNProxy Protocol Data Unit
FSB	FNProxy Strategy Base
OSI	Open System Interconnection
PDU	Protocol Data Unit
QoS	Quality of Service
SDO	Standard Development Organization
SFS	Synthetic FNQoS System
SFS	SFS Protocol
UML	Unified Modeling Language

4 Protocol mechanisms in BFS

4.1 Description of BFS

In engineering implementation, UML should be used to express a specific FNQoS system, so as to improve the system's ability to adapt to FN. Attention should be paid to specific QoS requirement in FN environment, and FNProxies should be extracted for dynamic interactivity.

Various FNProxies interactions based on the Bi-S mentioned in ISO/IEC 21558-2 are distributed in an FNQoS system. When these dynamic service FNProxies constitute an FNQoS system, they can be divided into BFS and SFS.

BFS is the smallest FNQoS system. There are only two FNProxies in BFS. Two FNProxies can interact to form Bi-S. Its characteristics are: no matter whether there is Bi-S or not, when the two FNProxies interact with each other, the FNProxies do not need to report the impact of FNProxies to the FNQoS system, nor do they need to register or manage other operations.

The result of the interaction between two FNProxies is FHR. FHR is based on the technical characteristics of Bi-S. See ISO/IEC 21558-2 for technical characteristics of Bi-S. See Annex A for the quantitative method of FHR.

4.2 General interactive nature for FHR

4.2.1 FNProxy pairing situations

This subclause describes the fundamental mechanism of FNProxy interactions for generating FHR based on Bi-S.

The interaction between each pair of FNProxies in the FNQoS system can contribute to the comprehensive effect of FNQoS system. See Annex A for details. The contribution made by each pair of FNProxy interaction to the comprehensive effect of FNQoS system depends on whether each pair of FNProxies has both requirements and a service.

Figure 1 shows FNProxy A and FNProxy B in the FNQoS system. Both FNProxies can receive the information from the other FNProxy, but their requirements cannot be matched by other appropriate services, the two FNProxies not form a Bi-S. Either way, both FNProxies record and save each other's management information.

The solid line indicates that FNProxy A sends a message to FNProxy B, and the dotted line indicates that FNProxy B cannot feed back to FNProxy A according to its own situation. Figure 1 is the two quasi interactive FNProxies without Bi-S.

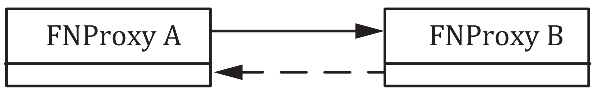


Figure 1 — Two quasi interactive FNProxies without Bi-S

Figure 2 shows the successful pairing of FNProxy A and FNProxy B under the condition of Bi-S effect.

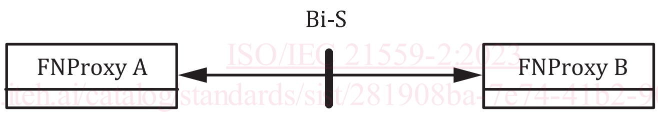


Figure 2 — Interaction FNProxy pairing success in FNQoS system

4.2.2 Active and passive functions of FNProxy

4.2.2.1 Active functions

When an FNProxy in an FNQoS system perceives the environment requirements and knows that it does not have the capabilities to complete the requirements, it will forward the situation to other qualified FNProxies according to its own strategy. The FNProxy's initiative is key. In this way it mimics the natural abilities of humans (i.e. belief, desire and intention).

Other FNProxies receive the information and responded to this FNProxy according to its strategy.

4.2.2.2 Passive functions

In the interface of any FNProxy, the capability and method for other FNProxies to query this FNProxy should be exposed. It is called the INQUIRY method.

4.2.3 Interaction model of BFS with engines

According to ISO/IEC 21558-2, there are three engines (perception, negotiation and execution) in any FNProxy. If an AI algorithm is involved in the three-engine runtime, it can invoke the function of the intelligence resource domain in ISO/IEC 21558-2 and usage strategy. Designers of FNQoS system are not required to study complex AI algorithms when dealing with various FNQoS scenarios.

The application of AI algorithms should be perception first, then negotiation, and finally execution. The three engines, which work in the following order, are the default configuration of the FNProxy: the perception engine, the negotiation engine, and the execution engine. The process that three engines execute in a sequence is called “the service cycle of FNProxy”.

Figure 3 shows a simplified FNProxy interaction model of BFS (two FNProxies are fnp1 and fnp2). Each FNProxy contains the three engines to work together. Since there are only two FNProxies, the designer will not consider the strategy of handling the transition, i.e. step c in the Figure 3 is represented by a dotted line. When this figure is used to analyse SFS, i.e. when the number of interactive FNProxies is more than or equal to three, FNProxies also transit services according to their execution strategy (ES).

There is also the strategy for FNProxy to generate a requirement. As shown in Figure 3, R1(ES1, E1), R2(ES2, E2): the current execution value E1, E2 of FNProxy A1, FNProxy A2 is respectively converted into the requirement value R1, R2 under execution strategy ES1, ES2.

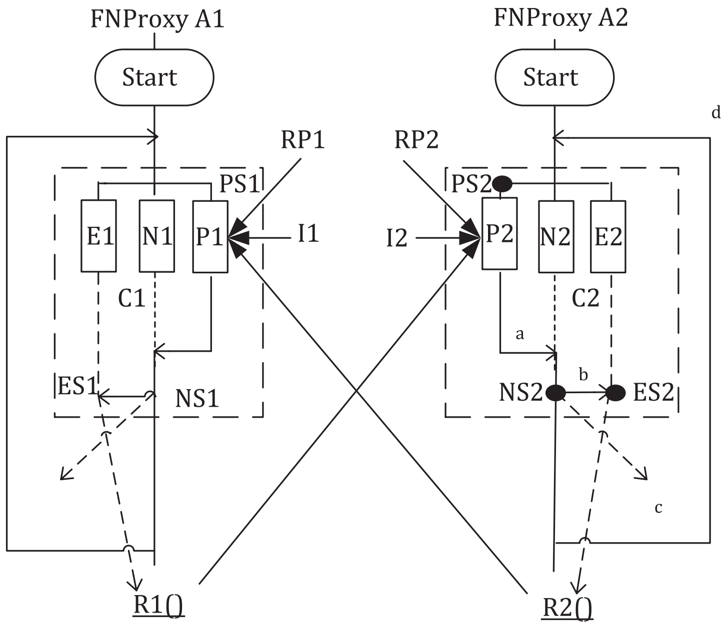
I1 and I2 show the interference received by FNProxy A1 and A2 respectively.

C1 and C2 show the capability to represent A1 and A2 respectively.

RP1 represents the real-time preference perceived by FNProxy A1.

PS1 and PS2 represent the perception strategies of FNProxy 1 and FNProxy 2 respectively.

The three small black dots marked in FNProxy A2 in Figure 3 are called perception strategy (PS1), negotiation strategy (NS1) and execution strategy (ES1). The strategy point indicates where the strategy is placed by the developer. The interaction framework model of BFS in the Figure 3 can be adapted to complex application scenarios.



Key

P Perceiving Engine
N Negotiating Engine
E Execution Engine
R Requirement of FNProxy
C Capability of FNProxy
I Interference received
RP Real-time preference perceived
PS Perceiving strategy
NS Negotiating strategy
ES Execution strategy
[a] Judging whether FNProxy capability can meet the perceived requirements.
[b] If the requirements can be met, it will be excuted.
[c] If the requirements cannot be met, transit to another FNProxy based on negotiation strategy NS2.
[d] After this requirement processing, continue to process the next requirements.

Figure 3 — Interaction model of BFS with three engine characteristics

4.2.4 FPDU definition of BFS

On the basis of traditional PDU, FPDU adds intelligent processing. The FNProxy senses the context change of FPDU in real time, and the FNQoS system can change the networking strategy in real time. Both the traditional communication network and AIEN are formed based on the interaction and cooperation of FNProxies.

The service of one FNProxy processing the other in a pair of interactive FNProxies is not exactly the same as the working service of OSI PDU processing between the lower layer and the upper. Many fields of FPDU are obtained by this FNProxy, instead of being transferred from traditional inter-layer processing. For example, target FNProxy number, this FNProxy requirements and FPDU style can be obtained from the negotiation strategy, execution strategy, and domain name of this FNProxy. If the requirements of this FNProxy cannot be perceived, there will be no FNProxy serving for this FNProxy.

Two FNProxies use BFS Protocol (BFSP) to interact.

Although there are various forms of FNs involved, FPDU (FNProxy Protocol Data Unit) can be composed of the following basic fields, which can meet the needs of interaction between two FNProxies. The designer of FNQoS application system can inherit and expand these basic fields according to the actual situation. The basic fields of FPDU are: this (Source) FNProxy number, the target FNProxy number, type of FPDU, requirements of this FNProxy and capability of this FNProxy, as shown below. It is abbreviated as: FPDU {Sn, GN, FS, Cap, Req}. The designer of FNQoS application system can inherit and expand these basic fields according to the actual situation.

```
FPDU

{

SourceNumber; /SN

GoalNumber; /GN

FPDUStyle; /FS

Capability; /Cap

Requirement; /Req

};
```

The semantics of the fields in FPDU are as follows:

Semantics of FPDU

{

SourceNumber: Source Number

/The value of this FNProxy's number

GoalNumber :Goal Number

/ In FNQoS systems with more than or equal to three FNProxes, the goal number (GN) FNProxy of is generally consistent with the link order of FLM. This is because the link order in FLM is fixed in advance. FLM records the corresponding GN that can be transferred when the FNProxy in the FNQoS system fails to sign a contract.

/ However, GN can also change in real time due to the following factors: the corresponding procedure, the context content, the algorithm of the special FNQoS system and the corresponding operators used.

FPDUStyle:FPDU Style

/When FPDUStyles are 0, 1, 2, 3 and 4, it means that FPDUStyles are more suitable for management, operation, intelligence resource, user and communication domains.

Capability:The FNProxy is given the maximum service capacity

/When the FNProxy provides services for multiple FNProxes, the percentage of the capability allocated to each requirement FNProxy can be obtained according to the needs of the corresponding application scenarios.

Requirement:Current Requirement of this FNProxy

/It refers to the requirements put forward by the FNProxy to other FN-Proxy according to the contract value and the FNProxy's own strategy before the FNProxy executes the new contract.

/ The type and size of the requirements proposed by the FNProxy vary according to the execution value and execution strategy of the FNProxy.

};

The subfield and semantics of requirement field are as follows:

Requirement

{

Type/ Semantics is the type of requirement

/ Generally, the requirement type is not directly related to the FNProxy characteristics. The requirement type of the FNProxy depends on the effort of the owner of the FNProxy and the strategy for it.

Value / Semantics is the value of requirement

/Value can be expressed either abstractly or concretely. When the requirement is abstract, the abstract expression can give the engineering meaning result of specific technology according to the scene.

};

The subfield and semantics of capability field are as follows:

Capability

{

Type / Semantics is the type of capability

/Generally, the type of capability is directly related to the FNProxy's characteristics, so that it can show the service capability of the FNProxy's own characteristics.

Value/ Semantics is the value of capability

/Value can be expressed either abstractly or concretely. When the requirement is abstract, the abstract expression can give the engineering meaning result of specific technology according to the scene.

};

4.2.5 Strategy processing scheme in FNProxy

The FNProxy strategy is the action plan that the FNProxy needs in order to be stimulated by the change when the state of the FNProxy in FNQoS system changes in the life cycle. The default important state is the output value of the execution engine, but it also encourages designers to develop complex important states composed of multiple factors and the action plan that FNProxy must respond to.

The execution engine of the FNProxy is affected by the FNProxy's own characteristics, capability, FNProxy owner and other factors. Any FNProxy will respond to e1, e2 and en stimulation separately. The response action plan is a sub strategy (scheme) that is pre-placed in the FNProxy strategy base (FSB). The sub strategies are: scheme 1, scheme 2 and scheme n. As shown in Figure 4.

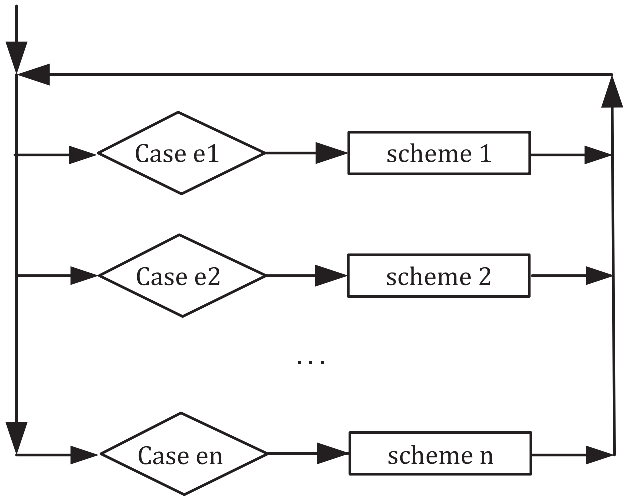


Figure 4 — Frame of strategy processing scheme in FNProxy

This FNProxy should be prepared by the designer in two ways: the first is the response measures sent by the FNProxy to the paired FNProxy according to the execution amount after the FNProxy completes the normal service execution. Pairing FNProxies treat their response value as their own perceived requirements.

On the other hand, when the FNProxy fails to reach a contract through negotiation, the FNProxy transits the unfinished service to another FNProxy selected according to its own situation.

4.2.6 Concept of the procedures in BFS

The concept of service effect of BFS can be understood as the sum of all the service procedures that are customized to solve various requirements based on the interaction between two FNProxies, i.e. the effect of FNQoS system is shown by all procedures, and each procedure includes a specific list of FNProxy sequential messages as follows:

FNQoS system = {Procedure list}

Procedure = {Sequential message list}

Although there are only two FNProxies in BFS, when the purpose and effect of the procedures supported by the two FNProxies are different, the interaction protocols between the two FNProxies are generally different. No matter what kind of purpose and effect of procedure in BFS, the protocol of FNProxy interaction in BFS should include three elements: the change of execution dynamic state of procedures (i.e. the so-called timing), the FPDU and its semantic change.

For example, in two procedures in BFS, such as the procedure of "start an FNProxy" and the procedure of "query an FNProxy", the FPDUstyle fields of the FPDU can be "M" (Management) and "O" (Operation) respectively. In addition, the FPDU of "start an FNProxy" procedure does not need extended fields, while the FPDU of "query an FNProxy" procedure needs extended fields (see special_FPDU in 5.6) to indicate that the query method is "INQUIRE", and the primitives and messages involved can be as follows:

Primitive:

Query (result, GN, Method)

Result: all methods and their functions of GN

GN: GoalNumber

Method: INQUIRE